PATENT SPECIFICATION

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COMPLETE SPECIFICATION

Improvements in the Tinning of Aluminium and Aluminium Alloys

We, BRITISH INSULATED CALLENDER'S CABLES LIMITED, a British Company, of Norfolk House, Norfolk Street, London, W.C.2, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to the tinning of aluminium that is to say the formation on the surface of the metal or alloy of a thin layer of tin or a tin alloy. The invention is also applicable to the tinning of aluminium alloys and hereinafter references to aluminium should be read as including its alloys. Tinning is usually carried out as a preliminary to the soft soldering or plumbing of the aluminium by processes in which conventional soft solders are used but the layer can also be applied as a corrosion resistant coating for the aluminium.

There are at present two methods in use for the tinning of aluminium without the use of fluxes. In one method the metal to be tinned is heated to a temperature at which the tinning alloy becomes liquid and the surface to be tinned is then rubbed with a stick of the tinning alloy, the surface being brushed with a wire brush before and after the application of the tinning alloy. The brushing, usually referred to as scratch brushing, is repeated alternately with the rubbing on of more metal from the stick, if necessary. The other method is the application of the tinning alloy directly to the aluminium surface by means of an ultrasonic soldering iron. Tinning alloys containing tin, cadmium and zinc with or without lead are at present in use.

Objects of the present invention are the formation of tin coatings which adhere well to aluminium and which when applied as a preliminary to soft soldering or plumbing result in the formation of soldered or plumbed joints which are highly resistant to the penetration of corrosion into the joint between the solder metal and the aluminium.

In accordance with the invention certain alloys of tin with magnesium and/or calcium, with or without lead, are used for the tinning of aluminium. In their simplest form the alloys consist of tin to which has been added .1—2% of calcium, .1—5% of magnesium or .1—7% of a mixture of calcium and magnesium. Part of the tin may be replaced by lead to make up a total lead content in the alloy of up to 70%. In other words the alloys used contain the metals referred to in the following proportions (all proportions are by weight):—

Lead	0—70%	
Magnesium	0—5%	the minimum content of calcium and/or magnesium being .1
Calcium	0—2%	
Tin	Remainder	

The tin alloys may also contain small quantities of the following additional metals:—cadmium, sodium or other alkali metals, e.g. lithium, copper, silver, bismuth, cerium or cerium mischmetal, and up to 20% of the lead may be replaced by the same weight of zinc. The total content of metals other than lead, tin, magnesium, calcium and zinc is preferably not greater than 1% and in any case not greater than 5% of the total content of the alloy. In general we prefer to use not more than 2% of magnesium or of magnesium plus calcium.

When applying the coating before making a soldered or plumbed joint it is desirable to extend the tinned surface beyond the area which will be covered by solder metal.

Many of the alloys are anodic to aluminium and thus afford cathodic protection to the surface of the aluminium, those that are not anodic are less cathodic to aluminium than conventional solder alloys. When spread as thin films on aluminium they have better corrosion resistance than alloys consisting of

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tin, cadmium and zinc with or without lead used in the same way.

The alloys of the invention have the advantages that they readily form a thin adherent coating on the surface of aluminium and that the layer thus formed is easily soldered or plumbed by conventional methods. The alloys are more economical in use than those at present in use for the tinning of aluminium and when the tinned surface is subscquently soldered or plumbed the joints formed are less liable to corrosion penetration than joints made after tinning with the tinning alloys at present in use.

The following are examples of alloys preferred for use in accordance with the invention:—

Example	Lead	Tin	Zinc	Magnesium	Calcium	Copper
I	50	49	—	1	—	—
II	40	49	10	1	—	—
III	30	68.5		1.5	—	—
IV	0	98	—	2	—	—
V	50	49.5	—	—	0.5	—
VI	50	49.25	—	0.25	0.5	—
VII	50	49.7	—	0.1	0.2	—
VIII	50	48.5	—	1.0	—	0.5
IX	50	48.5	—	1	0.5	—
X	50	49.4	—	0.5	0.1	—

Examples III and IV are eutectic alloys melting at 166 and 200° C. respectively.

The alloy which shows the greatest corrosion resistance when applied as a thin layer to aluminium is that of Example I and from this aspect it is the alloy preferred by the applicants. However all of the alloys containing higher proportions of lead within the range specified and about 1% or more of magnesium have the disadvantage that they are liable to inter crystalline corrosion in air, when in a form other than thin films, and sticks of the alloy must therefore be kept dry to avoid deterioration. For example sticks of the alloy may be wrapped in a film of regenerated cellulose or a similar material, or kept under oil or in moisture proof tubes (such as those used for packing cigars). The alloys containing calcium and very small quantities of magnesium have not this disadvantage but when in the form of thin films they have not as great a resistance to corrosion. The alloys containing magnesium and no calcium are easier to use than those containing calcium. When calcium alone is used, the proportion of metals in the alloy are preferably as in Example V. The alloys containing both calcium and magnesium preferred are those of Examples IX and X.

During the application of some of the alloys containing magnesium in accordance with the invention solid particles chiefly particles of inter-metallic compounds of lead and magnesium and tin and magnesium, appear in the molten layer. Their abrasive action helps the tinning process but they should preferably be brushed away from the area being tinned.

What we claim is:—

1. A body of aluminium tinned with an alloy containing 0—70% of lead, 0—2% of calcium and 0—5% of magnesium, the minimum content of magnesium and/or calcium being 0.1% the remainder being tin.

2. A body of aluminium tinned with an alloy containing 0—70% of lead, 0—2% of calcium, 0—5% of magnesium, the minimum content of magnesium and/or calcium being 0.1%, and not more than a total content of 5% of one or more of the following metals, cadmium, alkali metals, copper, silver, bismuth, cerium and cerium mischmetal, the remainder being tin.

3. A body of aluminium tinned with an alloy containing up to 70% of lead and zinc, the zinc content not being greater than one fifth of the lead content, 0.2% of calcium and 0—5% of magnesium, the minimum content of magnesium and/or calcium being 0.1%, the remainder being tin.

4. A body of aluminium tinned with an alloy containing up to 70% of lead and zinc, the zinc content not being greater than one fifth of the lead content, 0—2% of calcium, 0—5% of magnesium, the minimum content of magnesium and/or calcium being 0.1%, and not more than a total content of 5% of one or more of the following metals, cadmium, alkali metals, copper, silver, bismuth, cerium and cerium mischmetal, the remainder being tin.

5. A body of aluminium tinned with an alloy containing 50% of lead, 49% of tin and 1% of magnesium.

6. A body of aluminium tinned with an alloy containing 50% lead, 48.5% of tin, 1% of magnesium and 0.5% of calcium.

7. A body of aluminium tinned with an alloy containing 50% of lead, 49.4% of tin,

0.5% of magnesium and 0.1% of calcium.

8. A body of aluminium tinned with an alloy containing 50% of lead, 49.5% of tin and 0.5% of calcium.

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PROVISIONAL SPECIFICATION
No. 4522 A.D. 1952.

Improvements in the Tinning of Aluminium and Aluminium Alloys

We, BRITISH INSULATED CALLENDER'S CABLES LIMITED, a British Company, of Norfolk House, Norfolk Street, London, W.C.2, do hereby declare this invention to be described in the following statement:—

This invention relates to the tinning of aluminium, that is to say the formation on the surface of the metal or alloy of a thin layer of tin or a tin alloy. The invention is also applicable to the tinning of aluminium alloys and hereinafter references to aluminium should be read as including its alloys. Tinning is usually carried out as a preliminary to the soft soldering or plumbing of the aluminium by processes in which conventional soft solders are used but the layer can also be applied as a corrosion resistant coating for the aluminium.

There are at present two methods in use for the tinning of aluminium without the use of fluxes. In one method the metal to be tinned is heated to a temperature at which the tinning alloy becomes liquid and the surface to be tinned is then rubbed with a stick of the tinning alloy, the surface being brushed with a wire brush before and after the application of the tinning alloy. The brushing, usually referred to as scratch brushing, is repeated alternately with the rubbing on of more metal from the stick, if necessary. The other method is the application of the tinning alloy directly to the aluminium surface by means of an ultrasonic soldering iron. Tinning alloys containing tin, cadmium and zinc with or without lead are at present in use.

An object of the present invention is the provision of a process for the tinning of aluminium using alloys which do not contain large proportions of the relatively expensive metals, cadmium and zinc which are at present not readily available. Further objects are the formation of tin coatings which adhere well to aluminium and which when applied as a preliminary to soft soldering or plumbing result in the formation of soldered or plumbed joints which resist the penetration of corrosion into the joint between the solder metal and the aluminium.

In accordance with the invention certain alloys of tin with magnesium, with or without lead, are used for the tinning of aluminium. The alloys used contain these metals in the following proportions (all proportions are by weight):—

Lead	0—70%
Magnesium	0.1—5%
Tin	Remainder

They may also contain small quantities of the following additional metals—calcium, copper, silver, bismuth, zinc and cadmium. The total content of metals other than lead tin and magnesium is preferably not greater than 1% and in any case not greater than 5% of the total content of the alloy.

The following are examples of three alloys for use in accordance with the invention:—

Example	Lead	Tin	Magnesium	
I	50	49	1	Melting range 166° to 207° C.
II	30	68.5	1.5	Eutectic melting at 166° C.
III	0	98	2	Eutectic melting at 200° C.

During the application of some of the alloys in accordance with the present invention solid particles, chiefly particles of inter-metallic compounds of lead and magnesium and tin and magnesium, appear in the molten layer. Their abrasive action helps the tinning process but they should preferably be brushed away from the area being tinned. When applying the coating before making a soldered or plumbed joint it is desirable to extend the tinned surface beyond the area which will be covered by solder metal. It is also useful to apply a layer of the tinning alloy to the surface of the metal with which the soldered or plumbed joint is made, either in the region where this metal meets the tinned surface of the aluminium only or alternatively over the whole of the exposed surface of the metal. Because of the low melting point of the tinning alloys this can be simply carried out.

The alloys are anodic to aluminium and thus afford cathodic protection to the surface

of the aluminium. In stick form those alloys containing the higher contents of magnesium and lead within the range specified for use in accordance with the invention are liable to inter-crystalline corrosion and must therefore be kept dry, but in spite of this, these alloys when spread as thin films on aluminium have much better corrosion resistance than alloys containing tin, cadmium and zinc with or without lead used in the same way.

The alloys of the invention have the advantages that they readily form a thin adherent coating on the surface of aluminium and that the layer thus formed is easily soldered or plumbed by conventional methods. A number of the alloys within the range specified diminish auto-catalytic electrolytic action on the surface of the aluminium. The alloys are more economic in use than those at present in use for the tinning of aluminium and when the tinned surface is subsequently soldered or plumbed the joints formed are less liable to corrosion penetration than joints made after tinning with the tinning alloys at present in use.

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PROVISIONAL SPECIFICATION
No. 23143 A.D. 1952.

Improvements in the Tinning of Aluminium and Aluminium Alloys

We, BRITISH INSULATED CALLENDER'S CABLES LIMITED, a British Company, of Norfolk House, Norfolk Street, London, W.C.2, do hereby declare this invention to be described in the following statement:—

This invention relates to the tinning of aluminium, that is to say the formation on the surface of the metal or alloy of a thin layer of tin or a tin alloy. The invention is also applicable to the tinning of aluminium alloys and hereinafter references to aluminium should be read as including its alloys. Tinning is usually carried out as a preliminary to the soft soldering or plumbing of the aluminium by processes in which conventional soft solders are used but the layer can also be applied as a corrosion resistant coating for the aluminium.

There are at present two methods in use for the tinning of aluminium without the use of fluxes. In one method the metal to be tinned is heated to a temperature at which the tinning alloy becomes liquid and the surface to be tinned is then rubbed with a stick of the tinning alloy, the surface being brushed with a wire brush before and after the application of the tinning alloy. The brushing, usually referred to as scratch brushing, is repeated alternately with the rubbing on of more metal from the stick, if necessary. The other method is the application of the tinning alloy directly to the aluminium surface by means of an ultrasonic soldering iron. Tinning alloys containing tin, cadmium and zinc with or without lead are at present in use.

An object of the present invention is the provision of a process for the tinning of aluminium using alloys which do not contain large proportions of the relatively expensive metals, cadmium and zinc which are at present not readily available. Further objects are the formation of tin coatings which adhere well to aluminium and which when applied as a preliminary to soft soldering or plumbing result in the formation of soldered or plumbed joints which resist the penetration of corrosion into the joint between the solder metal and the aluminium.

In accordance with the invention certain alloys of tin with calcium, with or without lead, are used for the tinning of aluminium. The alloys used contain these metals in the following proportions (all proportions are by weight):—

Lead	0—70%
Calcium	0.1—2%
Tin	Remainder

They may also contain small quantities of the following additional metals:—zinc, cadmium, sodium or other alkali metals, e.g. lithium, certain of the rare earth metals, e.g. cerium alone or cerium-mischmetal. The total content of metals other than lead tin and calcium is preferably not greater than 1% and in any case not greater than 5% of the total content of the alloy.

The following is an example of an alloy for use in accordance with the invention:—

Lead	50%
Tin	49.5%
Calcium	0.5%

When applying the coating before making a soldered or plumbed joint it is desirable to extend the tinned surface beyond the area which will be covered by solder metal. It is also useful to apply a layer of the tinning alloy to the surface of the metal with which the soldered or plumbed joint is made, either in the region where this metal meets the tinned surface of

the aluminium only or alternatively over the whole of the exposed surface of the metal. Because of the low melting point of the tinning alloys this can be simply carried out.

Many of the alloys are anodic to aluminium and thus afford cathodic protection to the surface of the aluminium, those that are not anodic are less cathodic to aluminium than conventional solder alloys. When spread as thin films on aluminium they have better corrosion resistance than alloys containing tin, cadmium and zinc with or without lead used in the same way.

The alloys of the invention have the advantages that they readily form a thin adherent coating on the surface of aluminium and that the layer thus formed is easily soldered or plumbed by conventional methods. The alloys are more economical in use than those at present in use for the tinning of aluminium and when the tinned surface is subsequently soldered or plumbed the joints formed are less liable to corrosion penetration than joints made after tinning with the tinning alloys at present in use.

The alloys can be made by melting lead and adding to it first calcium and then tin. Alternatively a lead-calcium master alloy is prepared and this is added to molten lead or molten lead-tin alloys. Reasonable precautions must be taken to prevent oxidation of the calcium.

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